BIOLOGY OF *LEPTURA PACIFICA* (LINSLEY) (COLEOPTERA: CERAMBYCIDAE)[1]

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ABSTRACT

Larvae of the rarely encountered cerambycid *Leptura pacifica* (Linsley) have been discovered in the arid mountains of southern California infesting the living, dying, and dead branches of living scrub oak, including *Quercus dumosa* Nuttall. The larvae are often found in association with old workings of the cerambycid *Purpuricenus dimidiatus* LeConte, and in some cases they appear to rework the frass of *P. dimidiatus*. Development probably requires about 3 years, larvae of 2 distinct sizes occurring during and immediately after the flight period of the adults.

Linsley (1940) described a new lepturine cerambycid, *Strangalia pacifica,* from a single female specimen "beaten from oak" at "Pinon Flats" on the arid southeastern margin of the San Jacinto Mountains in Riverside County, California. The species presently stands as *Leptura (Leptura) pacifica* (Linsley) (Linsley and Chemsak 1976). For three and a half decades after its discovery, less than a dozen specimens of *L. pacifica* were collected and nothing was known of its larval biology, although several of the specimens were taken in association with oak.

In June, 1975 while collecting larvae and adults of the cerambycid *Purpuricenus dimidiatus* LeConte from living branches of scrub oak at Piñon Flat (see Hovore and Giesbert 1976), the junior authors and R. L. Penrose also encountered an occasional lepturine larva. The latter were presumed to be larvae of *L. pacifica,* but as attempts to rear adults were unsuccessful, positive identification was not made. On May 2, 1976 the senior author, also collecting *P. dimidiatus* at Piñon Flat, discovered a lepturine pupa in a partially chlorotic, 2 cm diameter branch of the scrub oak *Quercus dumosa* Nuttall. Three days later a female *L. pacifica* emerged (Fig. 1). Returning to the locality on May 8 and June 5, 1976, the authors collected a few more adults of both sexes of *L. pacifica* from their pupal cells. With knowledge of the habits of *P. dimidiatus* and *L. pacifica* from Piñon Flat, the authors were able to locate both species in a similar habitat at Upper Covington Flat in the Little San Bernardino Mountains. From our observations and those of A. E. Lewis and G. C. Walters, Jr., made at both localities on various dates from May to mid November, we now summarize the biology of *L. pacifica.*

The collection site at Piñon Flat lies at an elevation of approximately 1220 m, and the ecotonal floral community is characterized by *Q. dumosa, Pinus monophylla* Torrey and Frémont, *Juniperus californica* Carrière, *Nolina parryi* Watson, *Agave deserti* Engelmann, *Yucca schidigera* Roezl,

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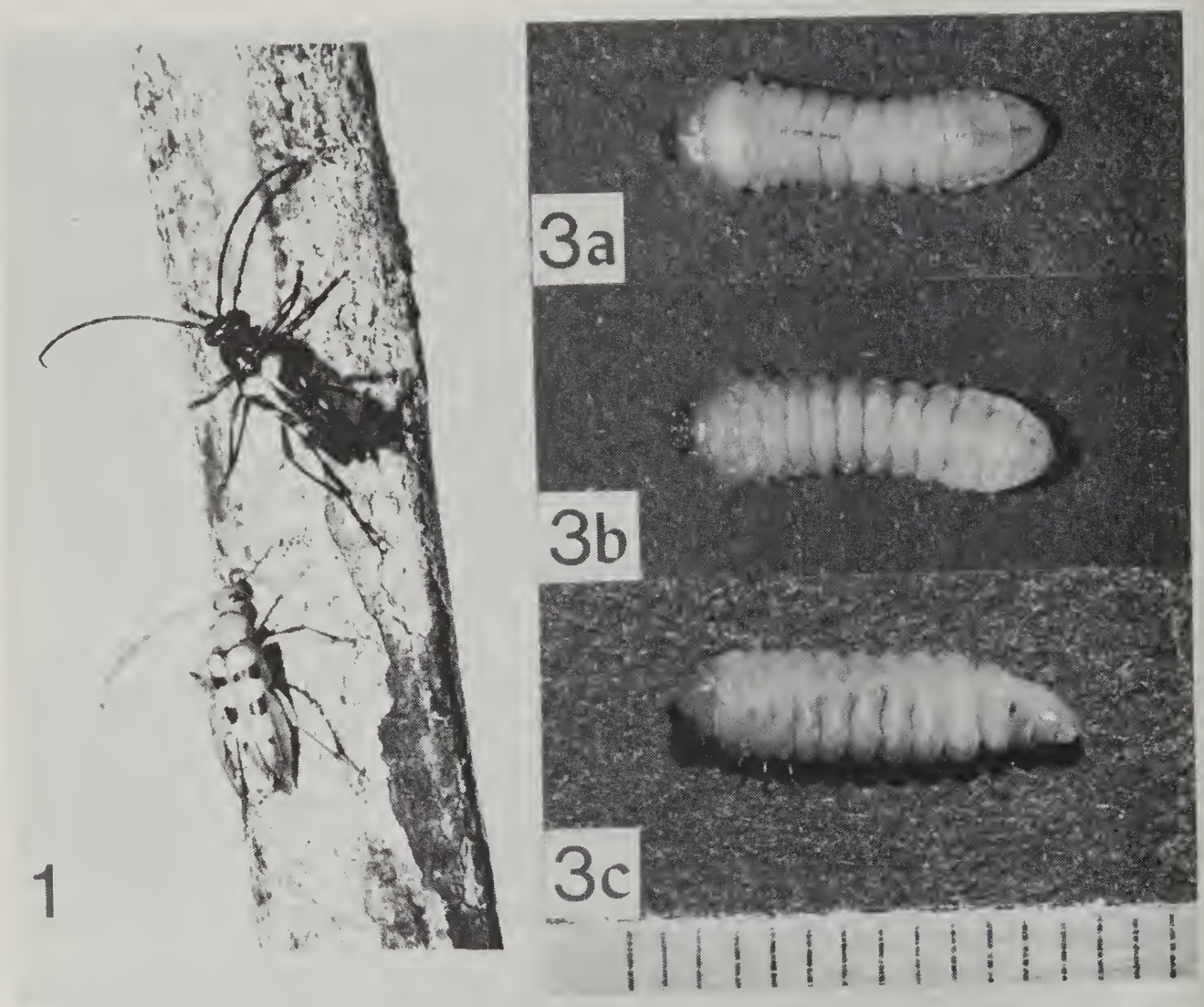

Fig. 1. Adults of *Leptura pacifica* (Linsley) taken at Piñon Flat from pupal cells in *Quercus dumosa* Nuttall. Upper, male; lower, female.

Fig. 2. Piñon Flat habitat of *L. pacifica*. Foreground, *Opuntia sp.* and *Q. dumosa* containing *L. pacifica* infestation. Background, *Pinus monophylla, Nolina parryi,* and *Juniperus californica.*

Fig. 3. Mid-instar larva of *L. pacifica*; a) dorsal view, b) ventral view, c) lateral view. Scale is in mm. Note the typical lepturine appearance. This larva and those shown in Figs. 4 and 5 were collected at Piñon Flat in early June just after the adult flight period.

and *Opuntia sp.* (Fig. 2). The second site, located in Joshua Tree National Monument, lies at an elevation of approximately 1480 m, and the floral community is distinctly similar to that at Piñon Flat with the exceptions that *Agave* is not present and the population of *P. monophylla* is very sparse.

To date, only the scrub oak *Q. dumosa* has been positively identified as a host of *L. pacifica*. However, the scrub oaks at both collection sites are extremely variable and it is possible that *Q. dunnii* Kellogg (*Q. palmeri* Engelmann), *Q. turbinella* Greene, or hybrid swarms of these species and *Q. dumosa* are present. It would not be surprising to find that *L. pacifica* infests tree oaks as well as several species of scrub oaks. Oak-infesting cerambycids are not noted for their fastidious selection of only one host species, and several species of oaks are found in the vicinity of Piñon Flat, including the tree oaks *Q. agrifolia* Neé and *Q. chrysolepis* Liebmann and a well defined population of *Q. dunnii*. Furthermore, *P. dimidiatus,* whose habits are in many respects remarkably similar to those of *L. pacifica,* has been found infesting *Q. dunnii* near Piñon Flat and *Q. agrifolia* and *Q. dumosa* in the coastal Santa Monica Mountains of Los Angeles County.

Quercus dumosa is occasionally arborescent but is most often a shrub 1-3 m high with several branches arising directly from the root crown. *Leptura pacifica* infestations have been found in healthy, living branches 1-3 cm in diameter (Fig. 4) and dying and dead branches up to 5 cm in diameter (Fig. 5). Any part of a living branch other than the distal portions a centimeter or less in diameter may be attacked. An occasional larval gallery even extends below the surface of the ground and some enter the root crown. In dead or dying branches, infestation occurs basally, adjacent to living wood. Presumably, this serves to maintain a necessary level of humidity within the larval gallery, or even to allow sap to enter. The odor of fermentation is often quite distinct in active galleries and it is possible that fungi or fermenting sap form part of the larval diet.

Whether in living or dead wood, the larval gallery is invariably quite damp and it appears that a high moisture level is essential to normal larval development. Feeding larvae removed from their original galleries and placed within freshly cut, living branches of oak generally continue to feed only briefly, suffer from desiccation and cease development. However, limited desiccation can sometimes be endured. One larva, kept in a vial for about four months, resumed feeding when provided with an artificial diet with a high water content. And living *Q. dumosa* branches collected in June, 1976 produced one adult female in May, 1977 and a second in July, 1977. Both adults were, however, about 30% smaller than adults taken from their pupal cells in the field.

The oval larval gallery (Figs. 4, 5) lies in the heartwood parallel to the grain and is usually 15 or 20 cm in length by the time pupation occurs. The yellow-orange larva (Fig. 3) works repeatedly up and down the branch, enlarging the diameter of the gallery to several times its own, and largely filling the gallery with a compacted mixture of feculae and excelsior-like frass. Unlike the larva of *P. dimidiatus,* the larva of *L. pacifica* does not girdle the infested branch. However, the workings of the latter are often sufficiently extensive to kill the distal portion of smaller branches. Although one largely chlorotic oak plant was found in which virtually every branch contained at least one *Leptura* larva, simultaneous

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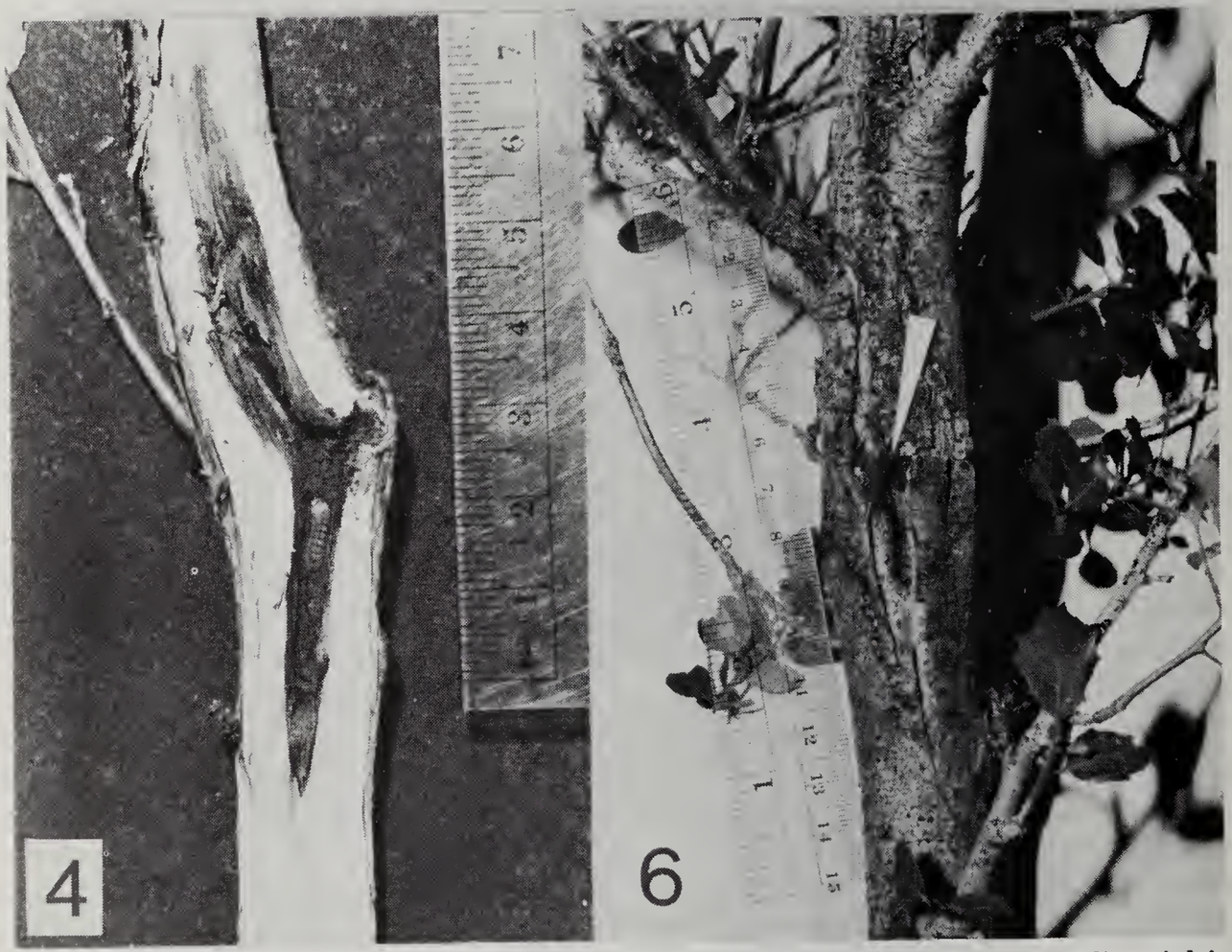

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Fig. 4. Mid-instar *L. pacifica* larva in gallery (frass removed) within living *Q. dumosa* branch not previously attacked by *P. dimidiatus*.

Fig. 5. Mid-instar larva of *L. pacifica* in a reworked gallery of *P. dimidiatus*. The lepturine frass ends just before the right cut, but the gallery continues well into the cut-off portion of the branch. Note that the gallery is far more extensive than that shown in Fig. 4, even though the larvae are of approximately the same size.

Fig. 6. Frass plugged emergence hole (indicated by white pointer) of *L. pacifica* in living *Q. dumosa*. A second plugged hole exists about 7 cm distad on the opposite side of the branch. A parasite subsequently emerged (and escaped unseen) from the second hole, leaving behind a silken cocoon.

infestation of the same plant by more than one or two larvae was seldom observed, and it appears that *L. pacifica* is rarely, if ever, responsible for the death of an entire plant.

Early in its development, the larva makes a small opening through the bark. As this opening generally does little more than rupture the bark and seldom shows signs of having been used for the expulsion of frass and feculae, it may function to permit the entry of fungi or even to allow the escape of acrid sap. As the larva enlarges its gallery, it generally constructs one or more additional openings through the bark. At least one of the openings is eventually enlarged to about 4 × 6 mm and plugged with a tight wad of excelsior-like frass. The larva pupates just below one of the larger openings and the adult ultimately chews through the frass plug and emerges. The construction of a frass plugged hole is not necessarily an indication that pupation is imminent, for one often appears a year or more before the adult emerges. The openings made by the larva are easily mistaken for twig stumps and natural fissures in the bark, making their detection in the field rather difficult. Pupation apparently occurs in the spring with the major emergence of adults at our study sites occurring during May and early June. The normal life cycle is presumably about 3 years, as larvae of two distinct sizes are found during and immediately after the adult flight period. The larger larvae (1 cm) are somewhat smaller than an adult and about twice the size of the smaller.

Quite often *L. pacifica* infests a branch adjacent to, and usually basad of, old *P. dimidiatus* workings. Particularly in dead branches, the two galleries may merge or almost completely overlap, and it often appears that the *Leptura* larva is reworking the frass of *P. dimidiatus*. It is interesting to note that larvae of the lepturine *Acmaeops collaris* (Linnaeus), which also infest dead oak, also appear to feed on the old frass of other cerambycids (Duffy 1953).

The habits of the adults remain poorly known. They have not been found on flowers [one specimen, illegibly labeled either "on" or "in" *Rhamnus californica,* Mill Creek, 6000 ft. San Bernardino Co., Calif., July 4, 1953 (Timberlake coll.), is in the Essig Museum of Entomology at the University of California, Berkeley (J. A. Chemsak, pers. comm.); the extremely fragrant flowers of *R. californica* Eschscholtz often attract large numbers of lepturines and other cerambycids], and they are rarely taken flying and only occasionally by beating. Mating behavior and oviposition have not been observed, and the pair shown in Fig. 1 could not be induced to copulate in the laboratory.

The most extensive observations of the behavior of adults of *L. pacifica* have been made by G. C. Walters, Jr., who collected 18 males at the Piñon Flat study site on May 2, 1977. Even though the population density of scrub oak at the locality is very high, all specimens were taken only in the immediate vicinity of two healthy, young *Q. dumosa* plants, and all were collected flying about the plants, sitting on the foliage, or walking on the branches. Some of the males flew directly into the plant and walked around on the branches as if searching for females; however, no females were observed. Like many other diurnal lepturines, the adults of *L. pacifica* are rapid flyers and when about to alight, often dance in the manner of certain Diptera and Hymenoptera.

The use of living oak by the larvae of *L. pacifica* is quite unusual for the genus *Leptura*. Species of the subgenus *Stenura* have been recorded only from decomposed or decaying hardwoods. Of the 11 North American species of the subgenus *Leptura,* the larvae of 9 have been recorded only from dead, primarily decaying, coniferous trees (Linsley and Chemsak 1976). It is interesting that the only member of the subgenus for which no host has been determined, *L. sequoiae* (Hopping), also appears to be *L. pacifica's* nearest relative.

The larval host records of all but a few species of the Lepturini are for dead, primarily decaying wood (Knull 1946; Duffy 1953; Linsley and Chemsak 1972, 1976). But this may simply be an artifact of the relative ease of finding infestations in, and rearing adults from, dead wood. The present discovery, together with the fact that the hosts of a rather large number of the Lepturini remain unknown, suggests that living wood may in fact be used by a number of other members of the tribe.

Adaptation of larval feeding preference to living as well as moist, dead wood is almost certainly advantageous in xeric habitats such as those at Piñon Flat and Covington Flat, and it is possible that *L. pacifica* has been able to persist at these localities in the face of increasing regional aridity by expanding its host preference. Initially, access to living wood might well have been exclusively via the exposed workings of *P. dimidiatus* or other insects.

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